PLANNING AND EVALUATING PRESCRIBED FIRES – A STANDARD PROCEDURE

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USDA Forest Service General Technical Report INT-43
INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE

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April 1978

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ACKNOWLEDGMENT

The fire use plan for the Burnt Mountain wildlife burn was prepared by John B. Roberts, fire management officer on the Missoula Ranger District, Lolo National Forest.

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RESEARCH SUMMARY

To implement the concept of fire management and provide a standard terminology, this paper proposes a standard fire use plan and report format.

A successful prescribed fire is described as one that is executed safely, burns under control, accomplishes the prescribed treatment, and attains the land and resource management objectives for the area involved. The following information is required for fire use planning:

1. Physical and biological characteristics of the site to be treated.
2. Land and resource management objectives for the site to be treated.
3. Known relationships between preburn environmental factors, expected fire behavior, and probable fire effects.
4. The existing art and science of applying fire to a site.
5. Previous experience from similar treatments on similar sites.

The fire use plan and report format has four parts. In Part 1, Treatment Area and Objectives, the planner states the purpose of the plan; describes the physical and biological characteristics of the site; and identifies land management objectives, treatment constraints, treatment objectives, and treatment alternatives.

The information assembled in Part 1 is used to write Part 2, Fire Prescription. The planner defines the results desired, the desired fire behavior, and the condition under which the fire must burn. He is further asked to describe treatment strategy, preburn monitoring needs, and how the fire will be evaluated.

The Burning Plan, Part 3 of the plan, is based on Part 2 and is the action plan. The planner must specify all the tasks involved in the preparation for burning, preburn monitoring, ignition, holding, mopup, and evaluation. For each task identified, the plan should tell when and how it will be done and who will do it.

Part 4 is the Report. It is designed to evaluate the plan in terms of the fire and its effects. Information requested concerns the actual accomplishment by the fire, the actual fire behavior, the environmental conditions under which the fire burned, and the cost. Observations and recommendations are also requested.

INTRODUCTION

A new philosophy called "fire management" (Moore 1974; DeBruin 1976; Kilgore 1976) has changed the attitudes of many natural resource managers toward fire protection and use. A generally accepted definition of fire management does not exist although several have been suggested (Barney 1975; Simard 1976). Fire management is difficult to define because the term is used to represent both a land management philosophy and a land management activity. As a management philosophy, fire management suggests that fire, in an ecological sense as well as a protection sense, should be considered when developing land and resource management objectives and that, once these objectives have been set, fire-related activities should be designed to support their accomplishment. As a land management activity, fire management includes all the tasks related to the protection of forests from unwanted fire, the use of fire to accomplish management objectives, and the inclusion of fire considerations in land and resource management plans.

The purpose of this paper is to propose a fire use plan and report format to implement the concept of fire management and to provide a standard terminology. For example, the terms "fire prescription" and "burning plan" are often used as synonyms. In the proposed format these terms have very specific and different meanings. This paper lists the elements that should be considered when planning fire use. It does not tell how detailed the information relating to these elements needs to be. The required resolution and precision of needed information should be specified in prescribed fire guidelines. The guidelines can be written for local or regional areas or for individual vegetative types. The fire use planning format proposed here can be used as an outline for the organization and content of such prescribed fire guides.

FIRE USE PLANNING

From a fire management perspective, a successful prescribed fire is one that is executed safely, burns under control, accomplishes the prescribed treatment, and attains the land and resource management objectives for the area involved. Successful prescribed burning requires planning. Such planning should be based on the following factors:

1. Physical and biological characteristics of the site to be treated.

2. Land and resource management objectives for the site to be treated.

3. Known relationships between preburn environmental factors, expected fire behavior, and probable fire effects.

4. The existing art and science of applying fire to a site.

5. Previous experience from similar treatments on similar sites.

The proposed fire use plan is designed to direct the prescribed fire planner through the above factors in a logical sequence. The proposed report is designed to provide a written record of actual prescribed burning experience that the planner can use when writing subsequent plans. The actual form of the resultant plan is left to the judgment of the planner or to the needs of his employer. Some prefer fill-in-the-blank plans while others favor narrative plans that vary according to the complexity of the planned fire. The primary concerns here are the thought process involved in planning fire use and the technical validity of the plan produced. One final point before considering the proposed format: it is assumed the decision to use fire has already been made. It is further assumed the decision to burn is compatible with land and resource management objectives for the area and these objectives are defensible from an ecological standpoint.

THE FIRE USE PLAN AND REPORT

The fire use plan and report format is in four parts. The first part deals with the planned fire treatment and the site to be treated. The prescribed fire planner is asked to describe the biological and physical characteristics of the site and to define the treatment objectives in terms of land and resource management objectives. The planner is also asked to identify all constraints that bear upon how prescribed fire can be applied to the area.

The information assembled in Part 1 is used to write the fire prescription, which is Part 2 of the proposed format. The first step in writing a fire prescription is to further define the treatment objectives in terms of the type and amount of work the fire must do. This is a critical task in the planning process. How well the fire accomplishes the desired work becomes the measure by which success or failure of the prescribed fire will be judged. Once the fire's work has been specified, the planner must draw upon existing knowledge of fire behavior and fire effects to determine (1) the type of fire behavior desired, (2) the environmental conditions under which the fire is likely to behave as desired, and (3) the burning techniques that must be used to get fire to behave as desired under these environmental conditions.

The burning plan, Part 3 of the proposed format, is based upon the fire prescription. The burning plan is the action plan, or project work plan, for a prescribed fire. It translates the fire prescription into on-the-ground tasks that must be performed before, during, and after the fire. For each task identified, the plan should tell when and how it will be done and who will do it. The needed equipment and supplies are listed and the cost of the project is determined. A properly prepared burning plan becomes the only document needed by the people responsible for conducting the planned prescribed fire.

Part 4 of the report is designed to evaluate the plan in terms of the fire and its effects. The purpose of this evaluation is to provide information for future fire use planning efforts. Too often such information is lost or only partially used by prescribed fire planners. Prescribed fire planners should keep a file of those reports, indexed appropriately for fast retrieval, and use them as a tool for fine-tuning subsequent fire prescriptions and burning plans. Fire information systems such as FIREBASE (Taylor and Eckels 1977) might be used to store and retrieve such information.

An expanded outline of the proposed fire use plan and report format follows:

Part 1 — Treatment Area and Objectives

1.1 *Purpose of Plan*--State briefly and in general terms the type of treatment planned and its purpose. For example:

--prescribed broadcast fire for hazard reduction and site preparation on a 35-acre (14.2-hectare) clearcut unit containing larch/fir logging slash
--prescribed broadcast fire for elk winter range improvement on a 500-acre (202.3 hectare) low elevation mountain shrubland
--prescribed broadcast fire for rejuvenation of 350 acres (141.6 hectares) of little bluestem grassland.

The only purpose of this statement is to identify the type of activity being planned. Such a statement would logically follow the decision to use fire, which has already been made.

1.2 *Treatment Area*--Identify and describe the physical and biological characteristics of the area to be treated. Use maps, graphs, tables, etc., to show:

--size of area
--location
--elevation
--landforms (slope and aspect)
--soil types (erodibility, susceptibility to damage)
--vegetation (species, cover types, habitat types)
--down and dead fuels (amount, size class distribution, depth, continuity, etc.)
--climate and weather patterns (seasonal averages, probability of occurrence of different weather patterns, etc.)
--wildlife and wildlife habitats.

Information on the above items often exists in ready to use form in land management plans, environmental statements and reports, resource management plans, and summaries of land and resource inventories.

1.3 *Land Management Objectives*--Summarize, very briefly, the land and resource management objectives and management guidance for the area to be treated. Refer to appropriate land management plans, resource management plans, silvicultural prescriptions, fire management plans, and other sources. For example (USDA Forest Service 1977):

Management Objectives--The management objectives for the National Forest land within this management unit are to (1) protect the aquatic environment by maintaining water quality for onsite and offsite use, (2) maintain the visual quality of the unit as reviewed from the major travel routes, and (3) manage the timber resource to maintain a healthy, productive forest within constraints imposed by watershed and visual concerns.

Management Guidance (National Forest Land)--Slash disposal will be complete enough to provide for free movement of wildlife through the management unit. Generally this means that slash concentrations more than 1-1/2 feet deep must be eliminated.

1.4 *Treatment Constraints*--Identify and define all constraints that bear upon how treatment can be applied. Consider:

--environmental constraints (air quality, water quality, accelerated erosion)
--multiple use constraints (protection of other uses, resource management trade-offs)
--economic constraints (maximum cost/acre)
--operational constraints (access, terrain, manpower, etc.)
--administrative constraints (agency policy, rules, etc.)
--legal constraints (State fire laws, forest practice acts, etc.).

Constraints are usually identified in the land management plan for the area to be treated. Other sources are agency rules, regulations, and policy; State and Federal laws; production rates and operational capabilities of men and machines; and project budgets.

1.5 *Treatment Objectives*--State in terms of land or resource management objectives referred to in section 1.3 and any constraints listed in section 1.4. For example:

--reduce potential rate-of-spread to "low," provide for free movement by wildlife, regenerate area naturally with 1,000 western larch seedlings per acre.
--increase the amount of redstem ceanothus on the area, rejuvenate decadent shrubs to make them more available and palatable for elk, and set back conifer encroachment.

1.6 *Treatment Alternatives*--Identify acceptable alternatives to the use of fire, if this was not done preceding the decision to use fire. State why they were not chosen.

This information can be important under certain circumstances whereby the manager must set priorities for burning because of time or manpower constraints. For example, the prescribed burning season might be shorter than expected due to persistence of adverse summer burning conditions into the fall. In such a situation, efforts can be concentrated on burning those areas for which no acceptable nonfire alternative exists.

Part 2 — Fire Prescription

2.1 *Treatment Specifications*

2.11 Desired accomplishment--*State, in precise terms, the work the fire needs to do*, i.e.:

--inches or percent of duff to be removed
--amount or percent of fuels to be reduced by size class
--amount or percent of mineral soils to be exposed
--vegetation to be killed or otherwise treated by species.

2.12 Desired fire behavior--Define the kind of fire needed to accomplish desired work while complying with any treatment constraints listed in 1.4, i.e.:

--rate-of-spread (fast or slow--specify acceptable range)
--fire intensity (hot or cool--specify acceptable range)
--flame height (especially if burning under a timber stand)
--flame length.

To obtain this information, use prescribed fire guidelines, fire models, fire effects literature, consultation with experts, etc.

2.13 Required environmental conditions--Define the conditions, or range of conditions, necessary to obtain the desired fire behavior and effects. Use prescribed fire guidelines, fire models, consultation with experts, etc. Consider:

--fuel moistures
--duff moisture
--windspeed and direction
--soil moisture
--temperature
--relative humidity
--physiological condition of vegetation (cured, dormant, etc.)

2.2 *Treatment Strategy*--Describe the sequence of events needed to achieve the treatment objectives and identify the tasks necessary for success:

--preburn tasks (slashing, snag felling, fireline construction, etc.)
--ignition technique (strip headfire, center fire, etc.)
--ignition methods (remote, drip torch, grenades, etc.)
--firing pattern or sequence.

2.3 *Preburn Monitoring*--Briefly describe how the area will be monitored to decide when conditions, specified above in 2.13, are correct for burning. Indicate the measurements to be taken, where they will be taken, and the precision needed. Consider the need for fuels inventory, fuel and duff moisture measurements, weather measurements, etc.

2.4 *Evaluation*--briefly describe how the treatment area will be evaluated to determine if treatment objectives, specified above in 2.11, were met. Specify measurements to be taken during the fire to evaluate fire behavior and measurements to be taken after the fire to evaluate fire effects.

Part 3 — Burning Plan

3.1 *Preparation for Burning*--For each preburn task identified in 2.2 of the prescription, specify:

--what will be done
--when it will be done
--how it will be done
--who will do it
--equipment and supplies needed
--cost.

3.2 *Preburn Monitoring*--For each monitoring task identified in 2.3 of the prescription, specify:

--what will be done
--when it will be done
--how it will be done
--who will do it
--equipment and supplies needed
--cost.

3.3 *Ignition*--On a map of the area to be burned, indicate ignition plan. Show sequence of ignition, placement of ignition crew, kind and location of ignition devices, etc., specify:

--what will be done
--when it will be done
--how it will be done
--who will do it
--equipment and supplies needed
--cost.

3.4 *Holding*--Indicate on a map of the burn area placement of men and equipment for holding fire in planned area. Indicate how escapes will be dealt with, specify:

--what will be done
--when it will be done
--how it will be done
--who will do it
--equipment and supplies needed
--cost.

3.5 *Mopup*--Describe plans or mopup and/or patrol after the fire has been conducted, specify:

--what will be done
--when it will be done
--how it will be done
--who will do it
--equipment and supplies needed
--cost.

3.6 *Evaluation*--For each evaluation task listed in 2.4 of the prescription, specify:

--what will be done
--when it will be done
--how it will be done
--who will do it
--equipment and supplies needed
--cost.

3.7 *Cost Summary*--Summarize planned costs for manpower, equipment, and supplies.

Part 4 — Report

4.1 *Accomplishment*--State in precise terms the actual accomplishment of the fire. For example, 3 inches (7.6 cm) of duff removed; 20 percent of area bare to mineral soil. Relate this to the desired accomplishment listed in 2.11 of the fire prescription.

Timing of fire effects evaluation is important. Some effects are apparent immediately after the fire and should be evaluated within a week. Other effects might not be apparent until the start of the subsequent growing season. In such situations, the report should be revised to include the longer term effects after they have been evaluated.

4.2 *Fire Behavior*--State the actual fire behavior that occurred. Relate this to desired fire behavior described in 2.12 of the fire prescription. Quantify, if possible.

4.3 *Environmental Conditions*--State the actual fuel moisture, weather conditions, and other designated environmental factors that preceded the fire and that occurred during the fire. Relate to those specified in 2.13 of the fire prescription.

4.4 *Cost*--State actual costs incurred. Explain any differences from estimated costs.

4.5 *Observations and Recommendations*--Summarize significant aspects of the fire in relation to expectations. Relate what actually happened to what was expected to happen. Indicate knowledge gained that should be considered when planning subsequent prescribed fires, for example (Norum 1975):

> Experience gained during this fire indicates a need to modify the ignition procedure for future hazard reduction burns in this fuel type. Because of the concentrated and discontinuous nature of the fuels, fires ignited across the lower edge of a plot often burned vigorously until a fuel discontinuity was reached, whereupon the fire went out. The result was a very ragged burn with hazardous fuel left in the center of the unit. Control and containment difficulties were experienced when ground fuels were sufficiently dry to carry fire between concentrations. Crown fires began to increase in frequency, and spotting outside of the prescribed area required alert patrol and vigorous suppression. Based on the results of this experience, I suggest ignition of strips of fuel across the slope, beginning at the upslope perimeter and progressing to the bottom of the plot. Permit each strip of ignited fuel to burn until the level of maximum intensity passes, then ignite the next downslope and adjacent strip. This procedure should assure ignition of all fuels and minimize control problems.

SUMMARY

A successful prescribed fire is one that safely and efficiently achieves the land and resource management objectives for which it was conducted. Such fires do not happen by accident; they are the result of careful and intelligent planning.

To plan a successful prescribed fire the planner must clearly define why he wants to burn a site and what he hopes to accomplish. He must also describe the physical and biological characteristics of the site to be treated. He must then blend this information with an understanding of the relationships between fuel, weather, topography, fire behavior, fire effects, and burning techniques. Finally, the actual fire must be evaluated in order to improve the performance of subsequent plans.

A fire use plan and report format is presented to guide the prescribed fire planner through the important steps for planning successful fire use. At the heart of this proposed planning format is the fire prescription, which tells what kind of fire is needed and identifies the conditions under which it must burn, and the burning plan, which tells how the prescription will be carried out on the ground.

A fire use plan for a planned prescribed fire on the Lolo National Forest is included as an appendix. This plan was written by a fire manager using the format proposed in this paper.

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APPENDIX

Fire Use Plan and Report for Burnt Mountain Wildlife Burn Spring 1978

John Roberts

Fire Management Officer

Lolo National Forest

Missoula Ranger District

Part 1 — Treatment Area and Objectives

1.1 PURPOSE OF PLAN

This project is a prescribed broadcast fire for habitat improvement on elk and mule deer winter and spring range.

1.2 TREATMENT AREA

a. Size of area. The treatment area contains 160 acres (64.75 hectares), of which 135 acres (54.6 hectares) will be burned.

b. Location. The treatment area is located at the head of Babcock Creek just east of Burnt Mountain in the south half of Section 28 and the southwest corner of Section 27, T11N, R16W. Access is by the Gillispie Creek Road #354.

c. Elevation. The treatment area extends from 5300 feet (1615 meters) on the bottom to 6385 feet (1946 meters) at the top.

d. Landforms. The slope of the area averages 30 percent or more and is mostly a southerly aspect.

e. Soil type. The area is comprised of loamy grassland soils which are mainly bedrock of quartzites and argillites. These soils are well drained with moderate to moderately rapid permeability and have no ash mantle. Surface erosion is low. They have a history of persistent grassland and meadow vegetation.

f. Vegetation. This particular area falls into the Ponderosa pine/Douglas fir savanna habitat group. The principal habitat type within this group is Douglas fir/Fescue (both Rough and Idaho). An analysis of the transect showed the following vegetation:

Fescue - 38%	Chickweed - 14%
Strawberry - 8%	Prairiesmoke - 4%
Lupine - 16%	Pussytoes - 4%
Other - 16%	

g. Down and dead fuels. Total fuel loading is estimated at less than 10 tons/acre (2.24 kg/m^2). This is mostly dead grass and forbs, with a scattering of tree needles and small dead twigs and limbs.

h. Climate and weather patterns. The Burnt Mountain area is located within a rain shadow of the Sapphire Mountains and receives approximately 21 inches (53.3 cm) of moisture per year. This occurs mainly in the form of snow. Almost all weather in the area is from the west with occasional storms coming from the northeast and east. These high wind storms from the northeast occur mostly in the fall and winter. The proposed burn time is planned for the spring, and adverse winds are not expected to be a problem. Early spring weather data is not available for the fire area or vicinity. Records are available from the now-defunct Bonita weather station (elevation 3544 feet or 1080 meters) for the period 1954-1968. Analysis of these records show the following 10-day means:

10-DAY MEANS FOR SELECTED WEATHER VARIABLES,

BONITA RANGER STATION, 1954-1968.

Weather Parameter	Period			
	May 1-10	May 11-20	May 21-31	June 1-10
Max. Temp. (°F)	62.7	66.8	70.1	70.5
Range	49.9-79.0	58.0-76.3	63.3-78.5	62.8-79.9
Min. Temp. (°F)	33.3	34.3	38.7	41.3
Range	26.1-40.8	30.1-41.1	34.5-44.3	36.4-47.7
4 p.m.(MST) Temp. (°F)	58.0	62.6	64.7	65.7
Range	46.4-76.3	54.3-73.4	55.7-73.2	58.4-75.1
4 p.m.(MST) RH (%)	42.9	37.1	42.6	45.3
Range	16.2-64.8	22.6-57.7	32.7-59.3	27.2-65.6
4 p.m.(MST) Wind (mi/h)	6.9	6.0	6.2	6.2
Range	3.8-13.9	4.0-9.6	2.8-12.2	2.5-9.8

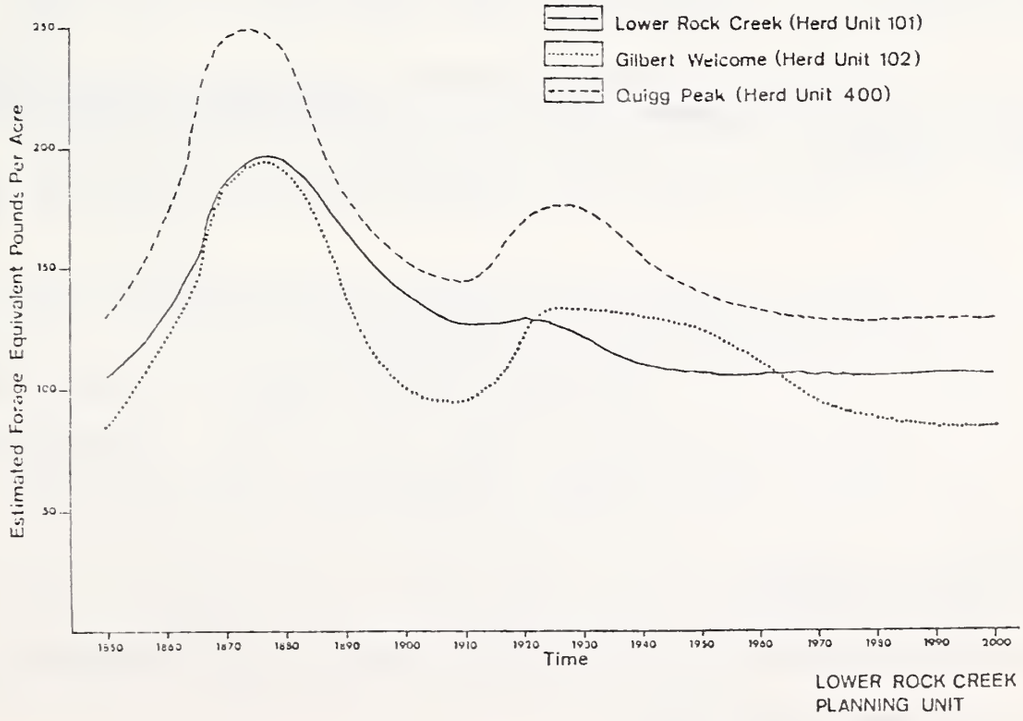

Figure 1.--Estimated pounds of deer-elk winter forage per winter range acre for three winter range units over a 150-year period.

i. Wildlife and wildlife habitats. The proposed burn is located within deer and elk winter range and is designed to increase forage production. The Burnt Mountain area falls within the lower Rock Creek herd unit. According to the Background Information Packet and Management Alternatives for the Lower Rock Creek Planning Unit (USDA Forest Service 1977), the area produced an estimated 200 pounds per acre (224 kg/ha) of deer and elk forage during the 1880's and has been on a steady decline since that time as shown in figure 1. The area now produces about 110 pounds of deer and elk forage per acre (123 kg/ha). This lower production rate is at least partially due to the fact that the area has not burned since before 1900.

1.3 LAND MANAGEMENT OBJECTIVES

The treatment area is identified as deer and elk winter range in the land use plan for the Lower Rock Creek Planning Unit. The management objectives for this area are to: (1) maintain the deer and elk habitat consistent with the needs of existing populations using the area, and (2) maintain naturally existing water quality.

A synopsis of the management guidance for the area follows:

1. Timber harvest and prescribed fire are methods which may be used to maintain the deer and elk winter range in a successional stage compatible with winter range management objectives.

2. Timber harvest will be directed toward maintenance and improvement of the deer/elk winter range.

3. Management activities will be modified as necessary to assure protection of the soil and water resources in areas with sensitive soils.

4. Management activities will follow the guidelines of the Modification Visual Quality Objective. (See Appendix in Lower Rock Creek Planning Unit, USDA Forest Service 1977.)

5. Slash disposal will be complete enough to provide for free movement of deer and elk through the management unit and to prepare sites for natural regeneration of browse plants.

6. Motorized vehicles will not be allowed in this management unit during the winter months.

7. If conflicts between cattle and big game become apparent in the future, the conflict will be resolved in favor of big game.

8. Immediate action will be taken to suppress wildfire. If fires are not controlled by initial attack forces, further control efforts will be determined on a case-by-case basis using guidelines contained in the fire management plan for the area. The guidelines will consider the management objectives of the management unit.

1.4 TREATMENT CONSTRAINTS

The following constraints govern the use of fire on the treatment area:

a. Environmental constraints.

(1) Air quality.

(a) Fuel moisture requirements should be such that ragged, long-smoldering fires do not occur.

(b) The burning period should be from early to midafternoon to facilitate smoke dispersion.

(c) At upper elevations (like this burn will be), very strong winds should be avoided as they tend to flow up and down the terrain intersected.

(2) Water quality.

The management objective for the treatment area (as outlined in the Lower Rock Creek Planning Unit, USDA 1977) calls for maintaining naturally existing water quality. This means that the water quality should not drop below a rating of "B-D_1" classification under Montana water quality criteria.

(3) Soil.

The management guidance for the Lower Rock Creek Planning Unit says that management activities will be modified as necessary to assure protection of the soil and water resources in areas with sensitive soils.

b. Multiple use constraints.

The treatment area is within the Spring Creek cattle allotment; and it also falls within the Visual Resource category of common landscape, seldom seen or not visible with modification permitted. (See visual resource map, Lower Rock Creek Planning Unit, USDA.)

c. Economic constraints.

A maximum of $750 is available for this project.

d. Operational constraints.

There will be no equipment other than hand-held used in conjunction with the burn.

e. Administrative constraints.

Escaped fire, as determined by the District Fire Management Officer, will be suppressed as per management guidance found in the Lower Rock Creek Planning Unit.

f. Legal constraints.

There are no legal constraints on the proposed burn area. It is just outside of Missoula County; therefore, no county burning permit is necessary. A courtesy call to the Missoula County Airshed Group may be in order, because the area is close to the county line.

1.5 TREATMENT OBJECTIVE

The primary objective of the fire is to increase the overall production of desirable forage on the area by: (a) increasing the production of forage and legumes, and by (b) improving the palatability of the fescue bunchgrass. Accomplishment of this objective will improve the area's capability to produce more deer and elk by providing more protein during the late spring and early summer--a critical factor for successful fawn and calf survival.

1.6 TREATMENT ALTERNATIVES

The alternatives to burning are:

a. Modify the area silviculturally through tree harvest. This could have the effect of increasing the size of the area slightly but may be offset by the disturbance caused from logging (invasion of weeds and the slow recovery of grasses on the bared soil). In this area, tree cutting is not an acceptable alternative because nearby areas have been cut so heavily that additional harvest may cause watershed damage.

b. Permit the cattle on the Spring Creek allotment to graze the area heavily enough to produce bare mineral soil for germination of forbs, or legumes This is not desirable because the effect would take longer than one year to accomplish and could promote the spread of weeds and increase the risk of surface erosion. Also, it is doubtful that the cattle could be held on the area long enough to produce the desired results.

PART II - FIRE PRESCRIPTION

2.1 TREATMENT SPECIFICATIONS

2.11 Desired Accomplishment

The fire should burn all of the dead bunchgrasses to within 1/2 inch (1.3 cm) of the root crown. Any other grasses, forbs, or legumes should be burned off at or near ground line. This will have the effect of producing approximately 30-40 percent bare mineral soil which would, in turn, improve germination conditions to permit increased forb and legume production. The woody fuels are scattered and discontinuous, and their consumption by the fire is desirable but not necessary.

2.12 Desired Fire Behavior

A relatively hot fire (remembering that fuels are less than 10 tons/acre or 2.24 kg/m^2) moving fast enough to consume all dead grass is required. Fuel moisture should be about 13 percent for the light fuels to assure good combustion and lessen the chance for smoldering fires. To obtain the best conditions, the burn should start between 11:00 a.m. and 1:00 p.m.

2.13 Required Environmental Conditions

Based upon the results obtained in Mormon Creek on a similar habitat type during the spring of 1977, the following conditions should be adhered to for best results.

Fuel moisture content for dead grass should not exceed 13 percent. Soil moisture content should not exceed 45 percent nor be lower than 25 percent. Windspeed can be up to 20 mi/h (32.2 km/h) with no problems, but ideal is 8-12 mi/h (12.9 - 19.3 km/h). Wind direction is no problem, just so it is steady from one direction. Normal wind direction is out of the southwest and up canyon.

Air temperature should be 50°F (10°C) in order to dry the grass to the desired moisture content. From 45° to 65° (7.2° to 18.3°C) would be within range to produce the desired effects.

Relative humidity should be between 35 and 45 percent, with 40 percent and falling being ideal. It is imperative that the bunchgrasses be cured. The cured condition is necessary to carry the fire, to produce bare mineral soil, and to release the nutrients necessary to stimulate the vegetation.

Percentage frequency of occurrence for the combination of weather parameters indicated in this prescription is about 16 percent during the period May 1 through June 10. This is based on 1954-1968 weather records from the Bonita Station. This figure does not reflect the occurrence of favorable prescription conditions prior to May 1.

The chance of obtaining favorable conditions decreases as season progresses as indicated below:

PERCENTAGE FREQUENCY OF OCCURRENCE FOR PRESCRIPTION

WEATHER CONDITIONS FOR THREE LEVELS OF WINDSPEED

Windspeed (mi/h)	May 1-10	May 11-20	May 21-31	June 1-10
5-9	10.7	14.6	8.3	7.4
10-14	9.3	3.1	2.8	2.7
15-19	3.1	0.8	0.7	1.4
Overall	23.1	18.5	11.8	11.5

2.2 TREATMENT STRATEGY

Preburn tasks - One trip into the area for final scouting and layout will be necessary. This can be incorporated into the fuel sample collection to determine moisture content. No slashing, snag felling, or fireline construction is necessary.

Ignition technique - Strip head firing will be used to burn the area. Smaller strips of about 5 to 10 feet (1.5 to 3.0 meters) will be used at the top to keep the burn within the unit. As the strips get to the road boundary (see map), they should be widened to 15 to 30 feet (4.6 to 9.1 meters) or more depending on fine tuning of the fire.

Ignition methods - Drip torches will be used (three of them).

Firing pattern - Strip head firing will be used starting at the east end of the block (see map, fig. 2) with the torchman starting across one at a time.

PROPOSED BURNT MOUNTAIN WILDLIFE BURN

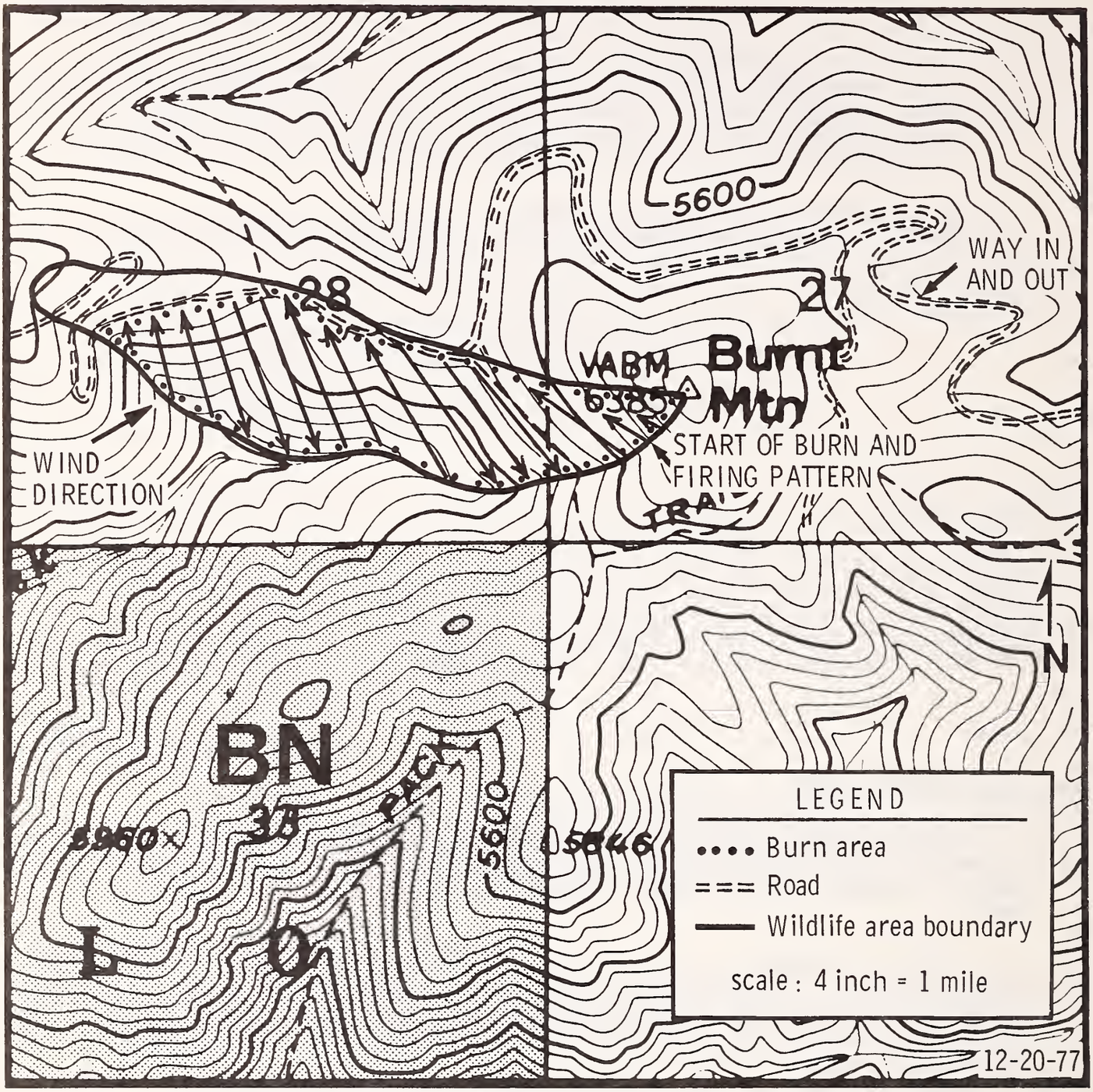

Figure 2

2.3 PREBURN MONITORING

Some monitoring will be necessary to determine if all snow is off the proposed burn area. This can be accomplished by driving up Rock Creek approximately 7 miles (11.3 km) to the mouth of Babcock Creek and looking up the creek toward Babcock Mountain to see if it is bare. If it is bare, then the Burnt Mountain area will also be bare. Once the area is free of snow, two days of sunshine with temperatures of 45°F (7.2°C) or more should pass before fuel and soil moisture samples are taken. Two samples each of bunchgrasses and soil should be taken at the top, middle, and bottom of the area to obtain an average fuel moisture and soil moisture percent.

When sampling the bunchgrasses, each individual clump will constitute a sample. All of the clumps will be cut as close to the ground as possible. The soil samples will extend to a depth of 4 inches (10.16 cm).

After collection, all samples will be weighed and ovendried, and moisture contents calculated. Relative humidity, wind direction and speed, and air temperature will also be taken in conjunction with fuel and soil samples. All of the samples will be taken as near to the planned hour of ignition as possible. This will probably figure out to a burn time of 11:00 a.m or slightly later.

2.4 EVALUATION

A permanent transect has been run through the area; and species composition, total pounds of forage, and percent of green vegetation have been calculated. Following the burn, this transect will be rerun in late June; and measurements will be taken to determine success of the burn in reducing the grass cover and exposing mineral soil.

PART III - BURNING PLAN

3.1 PREPARATION FOR BURNING

Four men will burn the area. These four men will do the final scouting and layout and will be familiar with the objectives of the burn and how it will be conducted. The final scouting and layout will be done when fuel and soil samples are collected to determine moisture content. The District Fire Management Officer will determine when the area is snow free. He will also act as burning boss and be one of the four men on the fire.

The following equipment is needed for the fire:

1. 2 4x4 1/2-ton pickups
2. 2 2-man snowmobiles and equipment
3. 6 drip torches filled at station
4. 10 gallons of extra drip torch fuel
5. fuel sampling kit
6. 4 personal portable radios
7. camera and film (35mm)
8. belt weather kit (don't forget vial of distilled water)
9. necessary forms and scratch paper
10. shovel and pulaski for each person
11. portable dictaphone machine.

The District FMO has the responsibility for the burn, seeing to the equipment, and keeping an accurate account of project costs.

3.2 PREBURN MONITORING

This includes determining when the area is ready for collection of fuel samples and when moisture content and weather conditions meet the prescription. These items are the responsibility of the District FMO. The FMO will also keep current with the weather forecast. This will be handled by phone calls to the local weather bureau. It may be necessary for an on-the-spot forecast, but most likely the weather will be a high pressure system which presents no problems.

3.3 IGNITION

Given the normal wind conditions (southwesterly and up-canyon winds), burning will start in the far east corner of the area at the top of Burnt Mountain. There will be three torchmen. The first torchman will fire out the corner. The second will strip head fire behind the first after the first man has completed his strip. The third man will start after the second has completed his strip. Once the three torchmen have completed their first strip, they will continue following the same lighting pattern until all of the block is burned. The firing pattern and burn area should be the same as that shown on the accompanying map.

Following is the necessary equipment for ignition:

1. 6 drip torches filled at the Ranger Station
2. 10 gallons of drip torch fuel
3. 4 personal portable radios
4. 35mm camera and film
5. portable dictaphone machine.

It is the responsibility of the District FMO to keep accurate cost records for the entire operation.

3.4 HOLDING

No holding is necessary. The burn will take place when the surrounding aspects still have sufficient snow to stop a ground fire. No equipment or supplies will be necessary for holding.

Escapes are not expected to be a problem because of the time of the year and the habitat type. Should any serious escapes occur (potential crowning in adjacent areas), they will be suppressed as rapidly as possible.

3.5 MOP-UP

No mopup will be planned, because the fuels are 1 inch or less in diameter and will not "lay over." No equipment or supplies are necessary for mop-up.

3.6 EVALUATION

During the burn, the District FMO will use the portable hand dictaphone to record the fire behavior, fire strategy, and preliminary treatment success. The permanent transect that was established in the late summer of 1977 must be reread during the latter part of June 1978 to ascertain the results of the burn. The following information must be calculated: (1) pounds of deer and elk forage/acre and also total pounds of forage/acre--this will be used to calculate the effectiveness of the burn, (2) available, usable forage for deer and elk, (3) percent of ground cover, (4) species variety.

The evaluation of the area will be done through the District Resource Assistant. He will furnish a competent person and the equipment necessary to do the job and make the calculations. Any help needed by the Resource Section will be furnished by Fire Management through the District FMO. The cost of the evaluation will be borne by Fire Management.

3.7 COST SUMMARY

Total cost of the project is estimated at $562. This is broken down as follows:

1. manpower - 8 man-days at $60.00/day = $480.00,
2. equipment use - 300 miles at $0.19/mile = $57.00,
3. drip torch fuel - 10 gallons at $0.50/gallon = $5.00,
4. miscellaneous = $20.00.

Headquarters for the Intermountain Forest and Range Experiment Station are in Ogden, Utah. Field programs and research work units are maintained in:

Billings, Montana
Boise, Idaho
Bozeman, Montana (in cooperation with Montana State University)
Logan, Utah (in cooperation with Utah State University)
Missoula, Montana (in cooperation with University of Montana)
Moscow, Idaho (in cooperation with the University of Idaho)
Provo, Utah (in cooperation with Brigham Young University)
Reno, Nevada (in cooperation with the University of Nevada)

☆ U.S. GOVERNMENT PRINTING OFFICE: 1981 — 777-021/1248 Region No. 8

Fischer, William C.
1978. Planning and evaluating prescribed fires--a standard procedure. USDA For. Serv. Gen. Tech. Rep. INT-43, 19 p. Intermt. For. and Range Exp. Stn., Ogden, Utah 84401.

Provides a standard format and checklist to guide the land manager through the important steps for prescribed burning. Describes the kind of information needed to prepare fire prescriptions and burning plans. Identifies the elements of a fire prescription, a burning plan, and a prescribed fire evaluation. A plan written for an actual prescribed burning is included as an appendix.

KEYWORDS: wildland management, fire management, prescribed fire, fire management planning.

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